Petroleum.—Russia and the United States are the two great petroleum producers. In the British Empire, Canada and Burma are the only oil regions deserving mention at the present time, though their output is, comparatively speaking, small.

Salt.—The United States and the United Kingdom produce about 2 million tons of salt each, Russia $1\frac{1}{2}$ million, Germany $1\frac{1}{3}$ million, India about 1 million.

Silver.—Here again the United States are the largest producers, followed closely by Mexico. Australasia furnishes an output nearly equal to one-third of that of the United States, and Bolivia and Germany approximately the same amount.

Tin.—The Malay Peninsula is *facile princeps* as regards the production of tin, probably yielding nearly two-thirds of the world's supply; and when aided by other British Possessions fully three-quarters.

Zinc.—The mines of Upper Silicia alone would suffice to make the German Empire *par excellence* the zinc-producing country of the whole world. The United States, after a long interval, take the second place in the list.

It must be carefully remembered that many valuable minerals are not mentioned: for instance, Cape Colony produces diamonds to the value of $4\frac{1}{2}$ millions yearly; Italy has no equal for its sulphur, Chili for its nitrate of soda, Germany for its potassium salts, Spain for its quicksilver, and the United States for their phosphates.

ON THE ORIGIN OF MAGNETO-OPTIC ROTATION.[1]

IT is known (*Phil. Mag.*, December 1897) that when in a material molecule there exists an independently vibrating group of ions or electrons, for all of which the ratio e/m of electric charge to inertia is the same, then the influence of a magnetic field H on the motions of this group is precisely the same as that of a rotation with angular velocity ω, equal to $\frac{1}{2}eH/mc^2$, imposed on the group around the axis of the field, on the hypothesis that the extraneous forces acting on the ions are symmetrical with respect to this axis. This result involves the main features of the Zeeman effect; it requires that the separations of the doublets representing the spectral lines arising from such a group must all be equal when measured in differences of frequency, or be inversely as the square of the wave-length in vacuum when measured in differences of wave-length, a relation which Preston has recently found to obtain for the natural series of lines in ordinary spectra.

The object of this note is to point out that it is possible to deduce the Faraday effect from the Zeeman effect by general reasoning, as regards any medium in which the optical dispersion is mainly controlled by a series of absorption bands for which the Zeeman effect obeys the above law, without its being necessary to introduce any special dynamical hypothesis. For this law ensures that the effect of the magnetic field on the periods of the corresponding free vibrations of the molecules is the same as that of a bodily rotation, say with angular velocity ω, round its axis;[2] while the complete circular polarisations of the Zeeman doublets, viewed in the direction of the axis, show that their states of vibration are symmetrical with respect to that axis. Thus, Ω being the angular velocity of the displacement vector in a train of circularly polarised waves traversing the medium along the axis, the state of synchronous vibration which it excites in the molecules will have exactly the same formal relation to this train when the magnetic field is off as it would have to a train with very slightly different angular velocity $\Omega \pm \omega$ when the magnetic field is on, the sign being different according as the train is right-handed or left-handed. Now, change of this angular velocity Ω means change of period of the light: thus the propagation of a circularly polarised wave-train when the field is on is identical with that of the same wave-train when the period is altered by its being carried round with angular velocity $\pm \omega$ and there is no influencing magnetic field.

This last result has been employed by H. Becquerel as a single hypothesis (suggested by Maxwell's notion of a magnetic field in this connection as a vortex in the medium) from which to deduce quantitatively both the Zeeman effect and the Faraday effect, and thus correlate them ("Sur une interprétation applicable au phénomène de Faraday et au phénomène et Zeeman"—*Comptes rendus*, November 8, 1897). He shows, employing chiefly the quantitative results of his own previous experimental investigations, that the hypothesis is capable of providing a satisfactory general view of the whole range of the phenomena, and in particular that it leads immediately to a simple law of dispersion for the Faraday effect, namely rotatory power proportional to $\lambda dn/d\lambda$ where n is the refractive index corresponding to wave-length λ measured in vacuum, a law which is in good agreement with Verdet's results for carbon disulphide and creosote.

The preceding argument provides a general dynamical justification of this hypothesis, for the case of all media in which the ordinary gradient of dispersion is mainly controlled by one or more powerful absorption bands beyond the visible spectrum, for all of which the Zeeman constants are the same: it also shows that Becquerel's hypothesis has an approximate validity when these constants are nearly the same for all the effective bands. In the immediate neighbourhood of any single band the dispersion is anomalous, and is controlled practically by that band alone; the application will then be exact, and in Becquerel's hands it has given a complete account of the excessive and anomalous rotation first observed by Macaluso and Corbino in sodium vapour for light adjacent to the D lines. As was to be anticipated, these simple general conclusions are consistent with the results of the more special dynamical investigations of FitzGerald and Voigt.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DR ROBERT MUIR, at present professor of pathology in the University of St. Andrews, has been appointed to the chair of Pathology in the University of Glasgow.

BY the will of the late Miss Elizabeth Brown, who died on March 5, the British Astronomical Association will receive her observatory at Further Burton, with the astronomical instruments in it, and the sum of 1000*l.*

Science states that Mr. John D. Rockefeller has offered 100,000 dollars to Denison University, Granville, O., if the friends of the institution will, within the next year, raise the sum of 150,000 dollars.

THE British Child-Study Association has issued the first number of a magazine entitled *The Paidologist*, which is to be published three times a year, and will be concerned with the physical and psychical aspects of child-life. The aims of the Association are both scientific and educational; and the new magazine is intended as a medium in which the results of research on child psychology shall be recorded, and practical suggestions which will assist in the evolutionary progress of the race shall be described.

WITH reference to the Board of Education Bill, the Council of the Association of Technical Institutions has unanimously adopted the following resolutions: (1) In reference to Section 2 of Clause 3, "That, inasmuch as in some counties and in most county boroughs the funds available are already fully appropriated for the purposes of technical education it is not, in the opinion of this Council, desirable that these funds should be applied to the payment of the expenses of inspecting schools under this Section." (2) "That, in the opinion of this Council, having regard to the fact that the funds assigned under the provisions of the Technical Instruction Acts are not more than adequate for the maintenance and development of technical education, it is essential that for the further purposes of secondary education additional funds be provided." It has also decided to take steps to endeavour to secure that the interests of technical education shall be adequately represented on the consultative committee named in Clause 4 of the Bill.

THE Commissioners appointed under the University of London Act, 1898, have given notice that they are now prepared to consider applications from duly qualified teachers and lecturers giving instruction of the University type in public educational institutions situate within a radius of thirty miles from the University buildings, who desire to be recognised as teachers of the University. By a "public educational institu-

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[1] Communication to the Cambridge Philosophical Society, March 6, by J. Larmor, F.R.S.

[2] The circumstance that the mean of the two disturbed periods is equal to that of the undisturbed line shows that no effect of constitutive type is involved in addition.

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tion" the Commissioners understand to be meant an institution for general education or for any special kind of education, which is not carried on for private gain or profit. Applications stating the applicants' qualifications should be addressed to the Secretary, Mr. T. Bailey Saunders, at the office of the Commission, 32 Abingdon Street, Westminster, S.W., on or before Saturday, May 13, 1899. It will, it is added, be convenient if teachers and lecturers in physics, chemistry, or other subjects, effective instruction in which requires laboratories and expensive apparatus, would state what resources of that character they have at their disposal. Teachers or lecturers on whose behalf applications have already been made by their colleges or schools need not repeat them.

At a meeting held in University College, Bristol, on Thursday last, the Bishop of Hereford, President of the College, being in the chair, it was decided to found a University College Colston Society, holding an annual dinner in the same manner as the Grateful Dolphin, and Anchor Societies, but with a distinctly educational aim. It was pointed out by the Bishop of Bristol that not only were the Colston benefactions to education larger than to all other objects combined, but that the sums devoted to this object in Bristol by Edward Colston were larger than those which have given origin to the existing annuities and doles. It is hoped that a Colston endowment fund may thus be raised, and scholarships instituted to enable girls and boys who have shown promise to pass on to the College from schools and other institutions in the city. The University College has recently fallen heir to a legacy of 5000*l.* bequeathed by the late Mr. Stuckey Lean. This will probably be devoted to a much-needed extension of buildings. Both the Bishop of Hereford and the Bishop of Bristol expressed opinions favourable to the establishment in the near future of that University for the West of England, centred in Bristol, which Sir Norman Lockyer foreshadowed when the British Association recently met in that city. We cannot but believe that the citizens of Bristol will speedily follow the lead set them by the citizens of Birmingham, and take active steps to enable those who have the cause of higher education in the West of England at heart to realise the ideal thus placed before them.

On Saturday last, in opening a new county school established at Presteign under the Welsh Intermediate Education Act, the Duke of Devonshire referred to the part he played in educational affairs. He remarked that he had on previous occasions had to protest against the assumption which seemed to have been made that he was, or professed to be in any degree, an educational expert. That was not the least the case. An educational expert should be a person who had himself received a very large and extensive education, and who had, in addition, devoted himself to the study of education, which was in itself a science and a profession. To neither of these could he lay the smallest claim. If, without the slightest pretension on his part, he had assumed to be in any sense an education advocate, it was because he had been for some considerable period deeply impressed with the national importance of the better training of the people in one branch, and that a very limited branch, of education—that was to say, in the teaching of science and of art as applied to our industries and to our commercial position. He had seen in many ways the close connection which existed between the discoveries and teaching of science and the efficiency and prosperity of our industries. He had seen how other countries appeared to be more alive to the existence of this close connection than we were ourselves, how in other countries the imparting of this kind of instruction had been made more the business of the State, and how they had been able to induce their people more fully to take advantage of the opportunities for this kind of education than we had hitherto succeeded in doing. But to see the necessity for this kind of technical training of the people, and to suggest the means by which it was to be provided, were two very different matters; and, although he had done his best to impress the views which he had formed on this subject on his fellow-countrymen, he had never professed, and he did not profess, to be an expert adviser as to the manner in which this technical training should be applied to our people.

Referring to the Board of Education Bill, the Duke of Devonshire said it had been his duty to bring in a Bill the object of which was the better organisation of education, and especially of secondary education. He thought the interests of the measure, which he believed to be an important one, might suffer if it were to be supposed that he, in the conduct of it, spoke as an educational expert with theories and ideas on education of his own, instead of being, as he was, merely a politician and an administrator charged with the duty of attempting to improve the organisation of our education with the assistance of experts who were much better qualified to advise and to give counsel than he was himself. This might be a good system or not a good system, but it was our system of government. We did not put a great strategist at the head of the War Department, or a skilful sailor, or a great shipbuilder at the head of the Admiralty. We selected ordinary statesmen or politicians to control these two great departments, requiring, as they did, the highest technical skill in the shape of skilled professional advisers. In his opinion, it would be a very great mistake indeed if we were to commit the charge of the Education Department to a professor, a schoolmaster, or an educational expert, however great might be the range of his studies, and however much he might have devoted himself to the study of the science of education.

SCIENTIFIC SERIALS.

Wiedemann's Annalen der Physik und Chemie, No. 2.—Propagation of electrodynamic waves along a wire, by A. Sommerfeld. To approximate to practical conditions, the author admits a finite thickness for the wire, and supposes it to be single, straight, and infinite. He shows that when the frequency is high and the wire thick, propagation takes place with nearly the velocity of light; but when that is not the case, the rate may be only three-quarters of that. All the occurrences are confined to a surface layer of the wire not more than 0·1 mm. thick.—Polarisation and hysteresis in dielectric media, by W. Schaufelberger. The loss of energy by hysteresis in a paraffin ellipsoid oscillating in an electrostatic field is proportional to the square of the electric force. Ebonite is, in comparison, a very imperfect dielectric.—Proportionality of emission and absorption, by W. Voigt. The author attempts to provide a theoretical foundation for Kirchhoff's law. He is obliged to assume the coexistence of irregular and heterogeneous waves, since regular wave-trains would not obey the law.—Canal rays, by A. Wehnelt. A mica cross introduced into the dark kathode space casts a shadow upon the kathode itself, thus proving that rays proceed from the anode to the kathode. Further, it is extremely probable that no kathode rays are given out except where anode rays impinge upon the kathode. When they penetrate the kathode, we have Goldstein's "canal rays."—A new method of detecting electric waves, by A. Neugschwender. A slit is cut in the silver surface of a mirror, and the latter is placed in circuit with a cell and galvanometer. No current is indicated until the mirror is breathed upon. But the deflection that is then shown is immediately annulled by the impact of electric waves upon the mirror. Conductivity is restored when the waves cease, provided there is a source of moisture, say a wet sponge, near the galvanometer.—Isolation of long heat rays by quartz prisms, by H. Rubens and E. Aschkinass. The extremely long heat rays obtained by successive reflections at surfaces of rocksalt and sylvine are transmitted by quartz, and their refractive index is thus easily determined. It is extremely high, being 2·19 for waves 56 μ long.—Continuity of the electric discharge in rarefied air, by Mr. Cantor. The author employs the coherer to test the continuity of the vacuum discharge under conditions where Hertz pronounced them to be absolutely continuous. In every case waves were given out by the tubes. But it is still possible that part of the discharge may have been continuous.

SOCIETIES AND ACADEMIES.

London.

Entomological Society, April 5.—Mr. G. H. Verrall, President, in the chair.—Mr. Blandford exhibited insects of different orders collected by Dr. Albert L. Bennett in West Africa, and read some notes by Dr. Bennett on the habits of the Goliath beetles.—Mr. McLachlan exhibited young larvæ of a "locust," received from Mr. E. A. Floyer, Director-General of Telegraphy in Egypt, and said by him to have caused the *Calotropis* trees in Nubia to be in a moribund condition. The

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